REMARKS

Claims 1 – 5 remain in the application. Claims 1 and 5 are in independent form.

Claims 1 and 5 have been amended to correct typographical errors which resulted in the examiner's misinterpretation of the claimed ranges. Appropriate amendments, fully supported by the specification, now limit the outer surface roughness of the wrist pin (R_a) at no greater than 0.10μm and the product of the Kurtosis value and the surface roughness (R_a) between 0.3μm and 0.60μm.

Addressing first the rejection of Claims 1 – 5 under 35 USC §112, 2nd para., the Applicant notes that surface roughness (R_a) is a universally recognized parameter described as the arithmetic mean of the deviation of a surface profile from a mean line over a given sampling length. It is normally determined as the average of results obtained through several consecutive sampling lengths. While surface roughness (R_a) can be directly measured using mechanical, optical or other techniques, it does not provide any information as to the shape of topographical characteristics of the surface. For example, a surface having a sinusoidal profile can have the same roughness measure as a surface with a saw-tooth profile, yet both surfaces exhibit vastly different sliding characteristics.

In order to better understand the topographical characteristics of a surface, the concepts of Skewness and Kurtosis are borrowed from the field of mathematical statistics. Both Skewness and Kurtosis are universally understood and accepted statistical analysis tools which are used to further characterize a collection of data points. When applied to a surface topography, Kurtosis yields a measure of the so-called "peakedness" or "spikiness" of the profile. The literature is replete with references to the use of

Kurtosis as an analytical tool in the field of material sciences.

Accordingly, since surface roughness (R_a) is a measure of surface deviation (peaks and valleys) from a reference plane, Kurtosis provides a deeper understanding by quantifying the sharpness of these peaks. A high Kurtosis distribution indicates a surface with sharper "peaks" and fatter "tails", while a low Kurtosis distribution indicates a surface with more rounded peaks with wider "shoulders". For spiky surfaces, the Kurtosis value is greater than 3. For bumpy surfaces, the Kurtosis value is less than 3. Perfectly random surfaces have a Kurtosis value of 3. Accordingly, the farther the Kurtosis value is from 3, the less random (i.e., the more repetitive) the surface is characterized.

Claims 1 – 5 stand rejected on grounds of indefiniteness. According to the Office Action, it is not understood how the Kurtosis value can be inversely proportional to the surface roughness. It is respectfully submitted that this is not an inherently indefinite concept. By "inversely proportional", the Applicant means that as one value rises, the other decreases in a proportional manner. Thus, as the Kurtosis value (i.e., the measure of the "peakedness" of the surface profile) decreases, the surface roughness (i.e., the average of the surface departures from a mean plane) increases by a proportional value. And, conversely, as the surface roughness decreases, the Kurtosis value increases by a proportional amount. For example, if the surface roughness (R_a) must approach the maximum 0.10μm, then the Kurtosis value of that roughness must be reduced proportionally, i.e., by decreasing the rate of incline of the peaks, into a range of 3.0 to 6.0 so that the product of the surface roughness and the Kurtosis value remains in the range of 0.3 – 0.60μm. As the surface roughness is reduced, the Kurtosis value can be

permitted to increase so that the peaks become more spiky. The claimed relationship between the Kurtosis value and the surface roughness is, in fact, a definite statement capable of being clearly understood and interpreted by those skilled in the art. Accordingly, it is respectfully submitted that, in light of the current amendments which correct typographical errors and thus place the claimed ranges within their intended context, the rejection of Claims 1 – 5 under 35 USC §112, 2nd para., has been overcome.

Turning now to the substantive rejections, Claims 1, 2, 4 and 5 stand rejected under 35 USC §103 as being unpatentable over Miyazawa in view of Maeda et al, Metals Handbook, and CRC Handbook.

Miyazawa discloses a two cycle piston assembly in which a connecting rod 40 is operatively joined to a piston 26 through a wrist pin 38. Needle bearings 43 are incorporated between the small end of the connecting rod 40 and the wrist pin 38. This is an extremely significant feature because the needle bearings 43 will constitute the lowest frictional interface between the oscillating connecting rod 40 and the piston 26. As such, there would not be an expectation of surface-to-surface rotational movement between the wrist pin 38 and the pin holes 36. Without an expectation of surface-to-surface movement, there can be no motivation to configure the surfaces like the claimed intention.

Accordingly, the Miyazawa piston assembly is not concerned with the specific problems addressed by the Applicant's invention. Specifically, because of the needle bearings 43, Miyazawa is wholly unconcerned with sliding surface-to-surface contact between its wrist pin 38 and the pin holes 36, or conversely between the wrist pin 38 and the connecting rod 40. Furthermore, Miyazawa fails to disclose that the wrist pin 38 has

a lay relative to its long axis. It further fails to disclose that the wrist pin 38 has an outer surface roughness no greater than 0.10μm, a Skewness of about -1.0 to 0.0, or a Kurtosis value such that the product of the Kurtosis value and the surface roughness is between 0.30 and 0.60μm.

Maeda et al discloses a piston 10 having a wrist pin bore. Maeda fails to disclose a wrist pin having an outer surface roughness no greater than 0.10μm, a Kurtosis value that is inversely proportional to the surface roughness such that the product of the Kurtosis value and the surface roughness is between 0.30 and 0.60μm, a Skewness of about -1.0 to 0.0, and a lay angle relative to a long axis of the wrist pin of 85 to 95 degrees.

Metals Handbook and CRC Handbook both teach principles of surface roughness, surface texture and the like. Not one of these references disclose controlling the relationship between the surface roughness (R_a) and the Kurtosis value such that they are inversely proportional to one another and their product yields a value between 0.30 and 0.60μm. Furthermore, none of these references disclose combining this inverse relationship between the surface roughness (R_a) and the Kurtosis value within the defined ranges, combined with a defined skewness range and lay angle range as applied to the wrist pin of piston assembly. Accordingly, Claim 1 and its depending Claims 2 – 4 are not rendered obvious by the prior art as applied, nor any of the prior art made of record in this application. Thus, it is respectfully submitted that Claims 1 – 4, as amended, are here presented in condition for allowance.

For the same reasons, the wrist pin *per se*, as set forth in independent Claim 5, is also believed to be presented in condition for allowance, taking into account the

correction of typographical errors. The Applicant notes that the rough calculations described in the Office Action, as taken from the CRC Handbook, estimated the Kurtosis value times the surface roughness at about 2μm. Taking into account the corrected typographical errors in Claim 5 (and in Claim 1), the claimed product range of 0.3 to 0.60μm falls substantially below the examiner's rough calculated number. Thus, the prior art does not teach controlling surface topographies within the claimed ranges.

While much technical literature has been developed in the matter of tribology, and specifically as applied to piston assembly and wrist pin components, the Applicants are the first to identify a novel relationship between surface roughness, Kurtosis (i.e., a measure of the surface spikiness), skewness and lay angle as applied to wrist pins. The Applicant has found this unique combination of features and properties to be particularly advantageous in providing a more efficient, longer lasting piston assembly and wrist pin. The claimed combination of features is nowhere suggested in the prior art, and is therefore believed to be properly protectable in this patent.

U.S. Patent 6,557,457, assigned to the assignee of this invention, is submitted on the accompanying PTO 1449 form. This patent does not anticipate or obviate the claimed invention, but is submitted herewith as related art.

It is believed that this application now is in condition for allowance. Further and favorable action is requested.

The Patent Office is authorized to charge or refund any fee deficiency or excess to Deposit Account No. 08-2789.

Respectfully submitted,

HOWARD & HOWARD ATTORNEYS, P.C.

9-1-05
Date

Jon E. Shackelford, Registration No. 36,003
The Pinehurst Office Center, Suite #101
39400 Woodward Avenue
Bloomfield Hills, Michigan 48304-5151
(734) 222-1098

G:\F\Federal Mogul Patent\IP00503\Amendment to OA dated 06-02-2005.doc